THE MONTHLY NEWS MAGAZINE OF THE NATIONAL BUREAU OF STANDARDS June 1976

DIMENSIONS NBS

A PUBLICATION OF THE UNITED STATES DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

DIMENSIONS NBS

JUNE 1976 / Vol. 60, No. 6 / ISSUED MONTHLY

CONTENTS

3 Attic Fans and Air Conditioners
NBS Engineers Take a Look at Summer Energy Conservation

6 Engineering in the Future—A New Profession

10 Science and Fashion
NBS Develops Proposed Garment Flammability Guidelines

12 Adventure Into the Unknown: Elliot Richardson Views Basic Research

16 Highlights

17 NBS Develops Door Security Standard

18 Symposium on Chemical Thermodynamics Planned

19 NBS Begins New Program to Check Laser Measurement Procedures

23 Publications

Nat. Bur. Stand. (U.S.) DIMENSIONS/NBS
CODEN:DNBSBG 60(6) 1-24

Superintendent of Documents Catalog No. C13.13:60/6

Library of Congress Catalog No. 25-26527

Cover: Can the energy-conscious homeowner benefit by operating an attic fan and an air conditioner simultaneously? The National Bureau of Standards has put this question to the test. See the story on page 3.

The National Bureau of Standards serves as a focal point in the Federal Government for assuring maximum application of the physical and engineering sciences to the advancement of technology in industry and commerce. For this purpose, the Bureau is organized as follows:
The Institute for Basic Standards
The Institute for Materials Rsearch
The Institute for Applied Technology
The Institute for Computer Sciences and Technology
Center for Radiation Research
Center for Building Technology
Center for Consumer Product Technology
Center for Fire Research
Formerly the TECHNICAL NEWS BULLETIN of the National Bureau of Standards.
For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Annual subscription: Domestic, $9.45, foreign, $11.85, single copy, 80 cents. The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 30, 1976.

ATTIC FANS AND AIR CONDITIONERS

NBS ENGINEERS TAKE A LOOK AT SUMMER ENERGY CONSERVATION

by Madeleine Jacobs
NBS public information specialist

IF you're thinking about buying an attic fan to reduce the load on your air conditioner this summer, you might first want to take a close look at a study by the National Bureau of Standards. A team of NBS engineers recently found that attic ventilation *does not necessarily* lead to a reduction in the amount of energy needed to air condition a building.

In fact, in the one-story building that was studied, the NBS team found that on hot summer days the energy needed for air conditioning alone was greater by as much as 7 percent with an attic fan in operation than without. In addition, in one case studied, the total energy consumption—the energy needed to operate both the air conditioner and the attic fan—was greater by more than 17 percent with the fan running continuously than when it was not used at all.

These findings may appear to be contrary to the popular conception that an attic fan will reduce energy needed to air condition a building, because the fan reduces the temperature of the attic—and therefore reduces the downward heat flow through the ceiling into the living areas below. Under certain circumstances, an attic fan may have this desired effect.

But an attic fan can also pull air from the air-conditioned rooms below into the attic space which is then replaced by an additional flow of outdoor warm air into the living spaces. This is especially likely to happen if there are air passages and leaks through the ceiling's construction—such as loose-fitting trap doors, pipe chases through the ceiling, leaks around ducts that penetrate the ceiling, air leaks through stud spaces into the attic, and leaks around light fixtures that penetrate the ceiling. This increased flow of warm air into the living space tends to cancel the beneficial effects of the fan. And, when you add the amount of energy needed to operate the fan to the

turn page

Attic fans may reduce attic temperatures, but insulation is a more effective energy conservation measure in many cases.

amount of energy used to cool the air conditioned space, the total amount of energy may be higher than if the fan had not been used.

Data Needed

The study* on the effect of attic ventilation on the energy required to air condition a one-story building was carried out by NBS engineers Chock I. Siu, Dr. Charles M. Hunt, and Dr. Tamami Kusuda of the Building Environment Division in the Center for Building Technology. They undertook the research because although it had often been speculated that attic ventilation leads to a reduction in energy required for air conditioning, experimental evidence supporting this conjecture was lacking.

The NBS study of attic ventilation was performed for the Tri-Services (Army, Navy, Air Force) on a one-story building at an army base in a suburb of Washington, D.C. The building was constructed originally in 1895 as a granary. After World War II, it was remodelled into an office building. About two thirds of the building is used for offices; the remaining area is a plumbing shop.

The red brick building has a gable roof, single pane glass windows, and about 15.2 cm. (6 inches) of glass wool insulation on the attic floor (about equivalent to R-19 insulation). The building has about 20 occupants and an air conditioner with a capacity of 1.5×10^9 Joules (5 tons). The gross floor area was 304 m^2.

The engineers instrumented the building to collect a variety of data. Attic air change rates and fan exhaust rates were determined using a tracer-gas technique and a calibrated hot wire anemometer. Solar radiation was measured by a calibrated pyranometer positioned at the south end of the building. Thermocouples were used to determine temperatures of the surface of the roof, attic air, room and ceiling, outdoor air, and air conditioner outlet air. Watt-hour meters were used to measure the power used by the central air conditioner and attic fan.

The energy consumption of the central air conditioner of the building was monitored when the attic fan was turned off and for three different modes of ventilation: continuous, cyclic, and selective. In the continuous mode, the fan operated constantly for a period of 48 hours. In the cyclic mode, the fan was left on for a period of 4 hours beginning at 8 a.m. and then turned off for 4 hours. This cycle was continued for a complete day. When operating, the attic fan provided about 5 air changes per hour in the attic space (an air change means a complete "turnover" of air in the space).

In addition, energy consumption for two selective modes was studied. In one, the attic fan was turned on during the night from 8 p.m. to 8 a.m.—and cut off during the day. In the other selective mode, the fan was turned on whenever the attic air temperature was 8 °C higher than outdoor ambient air temperature.

Data were collected during an exceptionally hot summer week in late August, in which the temperatures ranged from a low of 23°C at night to a high of 38°C. Solar radiation, outdoor air temperatures, and weather conditions were similar from one day to the next, except for the last day of testing when it rained for 3 hours. This meant that significant changes in energy consumption were not attributable to weather variations.

Computer Calculations

In addition to the experimental measurements, the engineers used a computer program developed at NBS to calculate the hourly room and attic air temperatures of the building for different values of attic air changes. The program, called NBS Load Determination (NBSLD), is capable of treating as many as 300 variables in three categories—the weather, the building, and the way the building is operated. The computer output is presented in the form of a profile of heating and cooling loads on an hourly, daily, weekly, monthly, or yearly basis. For this research, the NBSLD program was used to compute hourly values of room and attic temperatures and compare continuous operation and fan-off conditions. The computer predicted the times of maximum and minimum attic temperature. The calculated results were then compared with measured values.

Findings

What did the engineers learn? As expected, they found that the average temperature difference between the attic floor and ceiling below decreased when the attic fan was operating, but the reduction was only 1 °C to 3 °C. The corresponding reduction in heat transmission from the attic to the living space was only about 1 percent of the total cooling requirement of this building. The computer analysis correctly predicted the times of maximum and minimum attic temperatures, but it predicted a greater temperature change due to increased ventilation than was ob-

* ***The Effect of Attic Ventilation on the Energy Required to Air Condition a One-Story Building,*** **Building Environment Division, Center for Building Technology, National Bureau of Standards, Washington, D.C. 20234.**

Many types of attic ventilators are available commercially. Gable-mounted ventilator at left goes in the attic side wall with intake louvers on the opposite wall. Roof-mounted units, in the center, pull air in through side wall or under-eave louvers. Turbine ventilators at right are wind powered and can be installed on almost any roof.

served. The difference between the observed and calculated temperatures was much smaller when averaged over a 24-hour period than it was at the maximum or minimum.

These findings showed that attic ventilation did produce a small reduction in attic temperature. However, the energy consumption of the air conditioner with the fan on was not reduced compared to energy use without the fan for three of the four modes of fan operation. In fact, measurements of the energy used to air condition the building showed that operating an attic fan to reduce the attic temperature resulted in a small *increase* in the energy used by the air conditioner over a 24-hour period in most cases (see table). The increase amounted to about 7 percent with the fan on during the night and off during the day and approximately 3 percent with the fan operating only when the attic temperature exceeded the outside temperature by more than 8 °C. The increase was 6 percent when the fan operated continuously. When the fan was operated on a cyclic, 4-hour cycle, a small decrease—about 1.4 percent—in energy used for air conditioning was measured.

These figures do not include the amount of energy used to operate the fan, however. When that factor is included, the beneficial effects on energy use derived from operating the attic fan are cancelled out. For the four modes of fan operation used in these tests, the increase in total energy consumption ranged from 4.2 percent to 17.9 percent.

Insulate First

What does this study mean to a homeowner? To begin with, NBS engineer Chock Siu explains that in considering the use of an attic fan, factors other than the decrease in temperature between attic floor and ceiling must be taken into account. These factors include air infiltration, building construction, weather conditions, and the outdoor temperature.

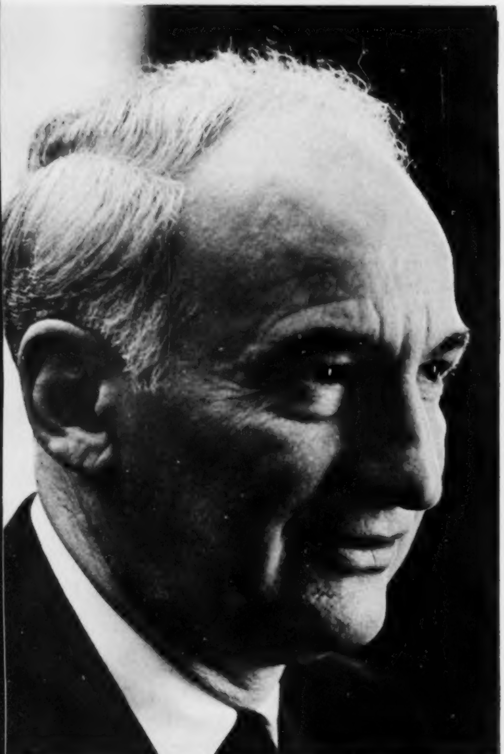
"In a totally uninsulated ceiling, heat gain through the roof may account for about 20 percent of total heat gain," Siu says. "However, a very important fact to point out to people considering an attic fan to reduce air conditioning load is that insulating the attic floor is more effective in reducing this heat gain than the use of an attic fan."

"Even in a house where there is some attic insulation, it is probably more beneficial to put in additional insulation and add other energy conservation measures," he says. Among the simpler measures Siu cites are

continued on page 20

ENGINEERING IN THE FUTURE
A NEW PROFESSION

by Dr. Simon Ramo



Simon Ramo was one of the speakers who participated in the NBS Distinguished Lecture Series.

The following is taken from an an address by Dr. Simon Ramo, Vice Chairman of TRW Inc. and chairman of the President's Advisory Panel on Contributions of Technology to Economic Strength, delivered at the National Bureau of Standards, Washington, D.C., on April 2, 1976, in celebration of the Bureau's 75th Anniversary.

WHILE our Nation today has more capability in science and technology than ever before, we are using it less—less as a fraction of its full, beneficial possibilities. Science and technology, fully employed, could improve the value of our resources, natural and human. These tools could be put to work to develop additional products so economically and socially advantageous as to warrant the investment of the required resources and whose production could create new jobs to reduce unemployment.

Future research could lead us to methods for increasing supply and lowering costs as a counter to inflation, substitutes for materials in short supply, and ways of acquiring raw materials and manufacturing that we need with less harm to the environment. But we have become slower, more timid, and less innovative in applying science and technology toward such possible ends.

Now, why are we not doing the best we can to reap the potential rewards of scientific research and technological effort? One reason is the growing "anti-technology" wave. A substantial fraction of our nation's citizens equate technology with the devil. In attaining our high production of goods and services, as they perceive it, we have lost much and gained too little.

Some will argue that the people who believe these things are failing to distingush between the tools of man and his use—his *misuse*, rather —of those tools, and we need only to explain the difference to them. However, a broad anti-technology bias is a handicap. It stands in the way of our arriving at meaningful value judgments and impairs our overall ability to reach objective, sound, non-emotional decisions on the use of technology.

An even more serious limitation to our wise employment of science and technology is the public confusion as to the right roles for free, private enterprise on the one hand and government sponsorship and control on the other. Thus, many people are convinced "business" is socially irresponsible. Another large fraction of the voters are equally fed up with government spending and big government generally. They see the government as a huge and increasingly incompetent and inefficient bureaucracy. As a capping indication of the confusion, it seems much of the population holds both of these extreme views at once. They distrust both the free enterprise sector's and the government's involvement with technology and can be counted on for a totally negative stance.

Thus, we see in the U.S. today a severe mismatch between the high potential of technological advance and the slow pace of the country's social-political progress. We are simply not organized to use science and technology to the fullest. It is the *interface* of technological with nontechnological factors that is critical and controlling. The whole is a "systems" problem. For instance, in

turn page

choosing where and how to apply science and technology it would be helpful to have clearer national goals. We cannot make satisfactory decisions on what to do without an understanding of trade-offs and options. We need to be in a position to compare the "good" that can come from technological advance against the "bad" and the cost.

As to our employment of technological change, we can be likened to a bunch of carpenters, sawing and hammering away, often getting fingers in the saws and hitting our own thumbs and each other's heads as we swing our hammers. We don't know quite what we are trying to build. We sense an unsatisfactory situation and meanwhile blame the saws and hammers.

A "New" Profession

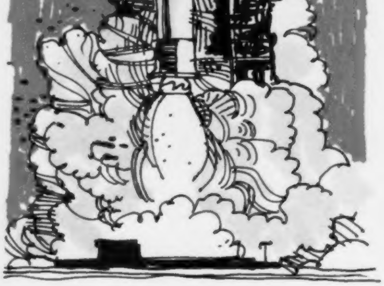
In listing factors highly influential in determining whether science and technology are used to the fullest for the public benefit, we must now mention one second to none, namely, the profession that is concerned with this issue. "Engineering" has meant to most, both in theory and in implementation, the utilization of resources to design and build machines and systems. We are in transition to a new, more highly technological society for which this definition of engineering, and the profession and activities it describes, falls far short of meeting society's requirements.

It is the overall matching of scientific and technological advance to social needs and progress that must constitute "engineering." The profession should include, but does not today, everything from recognition of need, articulation of options for filling it, analysis of technical-economic-social tradeoffs, to the planning, arranging, and actual implementation of the most sensible response—this whenever science and technology are expected to play a major part in the accomplishment. If engineering can not rise to this needed "greater engineering" plateau, this failure does not decrease the requirement. We have a missing profession.

Many changes must take place in education, image, motivation, practice, and organization to develop this necessary but presently non-existent profession. This can best be done if we first look at some examples of technological advances which the society could attain with benefit if we were to go about it correctly, but where the pace, quality, and clarity of effort today is unsatisfactory.

Wrong Approaches

Some aspects of coal technology constitute excellent examples of the problem of advancing technology occurring when the size and risk of the project and the number of independent players become too great. We know we can obtain gas and liquid fuel from coal, that coal can be mined more safely by using new concepts in mining machinery, and that it can be desulfurized and burned more cleanly.



However, the complete system needed for a much greater utilization of coal by the U.S. involves a host of private and public organizations that are rather autonomous and not readily directed from any one point: land owners, mine operators, labor unions, railroads, pipeline companies, power generating and water supply utilities, numerous specialized and engineering and manufacturing organizations, and many agencies in the Federal and state governments that deal with prices, environmental controls, labor, and transport, to name only a few.

The foregoing example helps illustrate that applying science and technology for the benefit of society is an enormously complex task transcending its science and technology ingredients. Combining knowledge and ideas on so many technical, economic, social, and political fronts is an intellectual challenge. Today's engineering deals with only a part of the task.

Education

True, most engineering educational institutions have for many years required that a typical engineering graduate include courses in the humanities and social sciences. But this practice has been largely to supply a veneer, a cultural coating, to make the engineering graduate a

fuller person. It has not been out of a recognition that understanding the way our society operates is as important as understanding physics for the profession the student expects to enter.

A number of universities offer "hybrid" courses of study—physics and economics, engineering and political science, biology and electronics—and, of course, some engineering graduates go on to take an additional degree in business, economics, or even medicine.

This multiple education equips these people for careers that are different from what would be open to them with an engineering degree alone. But the image is not that of creating a force of young people who will comprise the new profession looked to by the public as the source of leadership to cover the science to society relationship. That relationship is being covered instead by accidental, strained, contesting forces powered by people from all walks of life.

Getting There

Now, if this new level of professional activity is not available today, and if we want it in the future, how do we get there from here? If neither engineering nor any other profession is "it," how do we plant the new seed and make it grow? I submit that engineering is not ineligible even as it exists today as the starting point, although I am not sure that the new profession needs to be called "engineering." Perhaps it is "techno-sociology" or "socio-technology." But those two names are not good enough because they suggest a teaming of only two existing areas of endeavor, engineering and sociology. Perhaps it is better to call it poly-socio-econo-politico-techno-logy, or for short, "polylogy." What we call it is not the most important factor.

We should not expect to create the missing profession by merging an engineer with, let us say, an academic researcher in sociology. The latter is permanently essential in just what he is doing, at which he is presumably expert, and for which he presumably has natural talent and aptitude. The expanded profession we seek to define and create will be concerned, as is today's engineering, with getting things done. Again, like engineering, it is distinct from pure research. It is not concerned with attempting to enhance our understanding of the laws of nature, but it will profit and grow as that understanding grows.

University training for this "greater engineering" profession would inevitably have to include three main dimensions: (1) science and technology; (2) the society—the nature of man and his institutions and practical, social-political-economic disciplines related to making the society work; (3) interdisciplinary techniques, or "systems engineering in the large," for attacking problems through recognizing and handling interactions, multidimensional aspects, interfaces, compromises, alternatives, balances, and optimizations. The fullest use of science and technology for the nation requires understanding both science and the nation, and this thought would dominate the curriculum. In addition, since most real-life problems involve synthesis as well as analysis, methods would be found to bring out the creative as well as the analytical talents of the student.

To assemble a faculty that might be expected to turn out "polylogists" clearly requires a merging of talents and specialities to create a new kind of teacher as well. Obviously "greater engineering," like law or medicine or any major pursuit, will continue to have its highly detailed specialized aspects. Many professionals, probably most, and most of the graduates

continued on page 22

Science and Fashion

NBS DEVELOPS PROPOSED GARMENT FLAMMABILITY GUIDELINES

by Frederick P. McGehan
NBS public information specialist

THE high fashion houses of Paris, the bustling garment district of New York's 7th Avenue, and the textile mills of the South seem far removed from the tranquility of the National Bureau of Standards in Gaithersburg, Md. But people in each of these sectors of the multi-million-dollar fabric and garment industry are focusing attention on NBS. Why?

Because what Americans are wearing in the 1980's may be influenced by work performed by NBS' Center for Fire Research. For the past several years researchers have been working on a proposed standard for the flammability of general wearing apparel, under contract to the Consumer Product Safety Commission. In February, they forwarded a proposal to the Commission for consideration as a mandatory standard.

If the NBS proposal is adopted by the CPSC, it would mean that manufacturers of all wearing apparel, from suits and dresses to underwear and hosiery, will have to select their material and designs from criteria set out in the standard. The thrust of the proposal is to require that fabrics of low flammability be used in garments most likely to be involved in serious injuries, and that correspondingly less rigorous requirements be set for garments less likely to be so involved.

The story of garment flammability goes back to 1953, when Congress passed the Flammable Fabrics Act in the wake of problems with such items as brushed rayon sweaters that came to be known as "torch" sweaters. Basically, the Act took a Department of Commerce voluntary standard, CS 191–53, and made it mandatory for all apparel. That standard, which is still in effect today, eliminated the most dangerous fabrics but did little more. Until 1967, flammability standards under the Act could only be issued by Congress. Then in 1967 Congress gave the Secretary of Commerce the authority to develop and issue new standards under the Flammable Fabrics Act.

The first order of business of the Department of Commerce concerning wearing apparel was to issue a flammability standard for children's sleepwear. An accident data system established by NBS and now under CPSC responsibility (the Flammable Fabrics Accident Case and Testing System, FFACTS), showed that the incidence of accidental apparel fires was highest among children's sleepwear.

The Secretary of Commerce delegated to NBS the responsibility for technical support in developing a standard. NBS provided the test methods, investigated the technical ability of the sleepwear industry to comply with the proposed standard, and passed recommendations to the Secretary. The result was the publication of the first flammability standard for children's sleepwear (sizes 0 to 6x) in July 1971. Two standards for carpets and rugs were actually issued before the sleepwear standard.

When the Consumer Product Safety Commission was formed in 1973, the authority to develop and establish standards under the Flammable Fabrics Act was transferred to the new agency. NBS continued to perform a technical support role under contract to the CPSC. A second flammability standard for children's sleepwear (sizes 7 to 14) was published by the Commission in May 1974, as recommended by NBS.

With these standards issued, NBS then turned its attention to the technical problems of developing a standard for general apparel. It became apparent that the industry would have difficulty in coping with a number of different standards for each apparel product. Effort was focused on developing one test method, one standard for all wearing apparel.

Working under the leadership of James H. Winger, Chief of the Program for Fire Prevention—Products, a team of five researchers devised a

Data show that loose fitting, flowing garments are most often involved in fire accidents. Chances of an accident decrease with the tightness of the garment. Dress at left is a Class One garment (most hazardous) because of the loose-flowing sleeves and extended sweep of the skirt. Dress at the right is a Class Two (safer) garment, which means that the waist, sleeve and sweep of the skirt are of tighter fit.

new test method for apparel. The 1953 test basically involved igniting a piece of fabric in a test frame and measuring the rate of flame spread. While it indicated how quickly a particular piece of fabric burned, it didn't relate to the extent or severity of possible injuries. The new test for general apparel is based on measuring the amount of heat transferred from a burning fabric to a simulation of the wearer's body. It has become known as the "mushroom test" because of the configuration of the test apparatus.

The piece of fabric is hung from the top plate of the "mushroom" and copper heat sensors measure the amount of heat transferred from the burning fabric to the "stem" and "cap" of the device. Winger says that there is "widespread agreement" with the basic test concept among researchers in the textile industry, although there is some disagreement on test configuration.

Winger calls the draft general apparel standard "the most complex one yet developed under the Flammable Fabrics Act." The draft standard would require apparel *fabric* to be classified according to flammability (as determined by the mushroom test) and *garments* to be classified ac-

continued on page 20

ADVENTURE INTO THE UNKNOWN:

ELLIOT RICHARDSON VIEWS BASIC RESEARCH

Commerce Secretary Elliot L. Richardson spoke on April 3 before a meeting co-sponsored by the Moore County, North Carolina, Chapter of the American Cancer Society and the Comprehensive Cancer Center of Duke University. His topic was basic research as an investment in progress. The following is a condensation of that address.

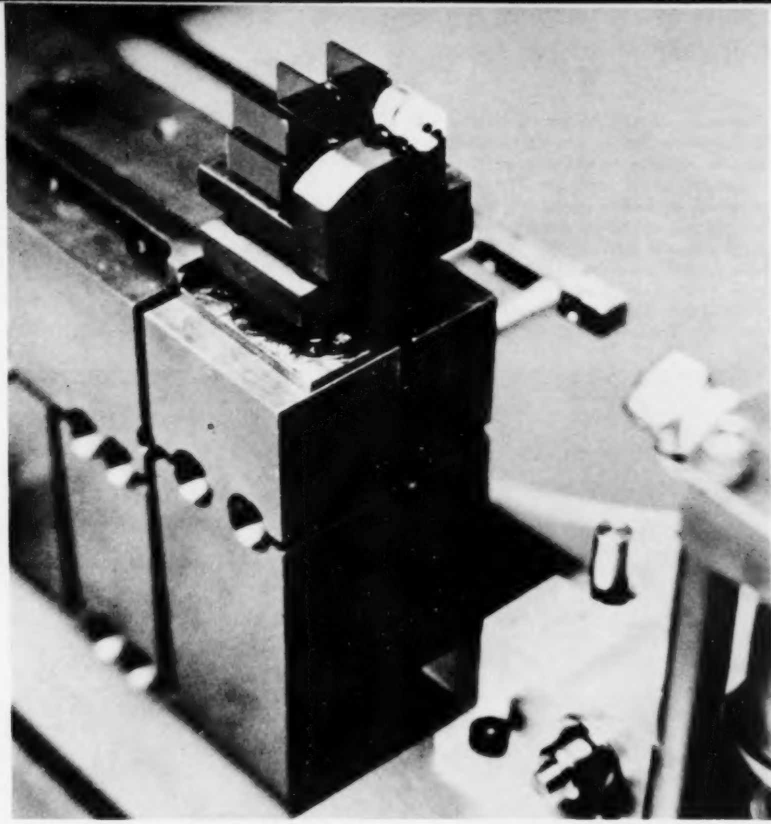
I hold no scientific degrees and no one would be less at home in a laboratory filled with test tubes or at a linear accelerator. But my experience in widely disparate fields convinces me that basic research is one of the best investments in long-term progress that we can possibly make. By its nature, it is given to long, thoughtful pauses, complexity, and obscurity. But it leads to knowledge and the need for that knowledge is fundamental, so profoundly fundamental that we only notice its absence —and are startled—when we find it gone.

Each day we face difficult choices in allocating our limited resources among a multitude of immediate and pressing problems. We need solutions as quickly and as economically as possible.

In our haste—and as what Thomas Carlyle called "tool-using animals"—we reach for what we know best: technology. We take the knowledge in hand and fashion it into a tool. We called the process "applied research and development." It can produce marvels, like putting a man on the moon. But there is nothing economical about it.

Cost of Technology

Indeed, there is nothing quite as expensive as sophisticated technology, and we don't have to cite the moon shot as an example. Consider the cost of the technology involved in health care—in treating a coronary, for example, or a disease like cancer. One of the most distinguished researchers in the cancer field, Dr. Mahlon B. Hoagland, president and director of the Worcester Foundation for Experimental Biology, points to the rapidly growing costs of attacking cancer through surgical, X-ray, and chemical procedures. And he adds: "This is technology we would



Basic research is an important part of the work of the National Bureau of Standards, particularly in the field of measurement science. Shown here is the heart of the X-ray/optical interferometer, used for measuring small distances very precisely. In 1974 it was used by a team of scientists headed by Dr. Richard Deslattes to determine the Avogadro constant, equivalent to weighing an atom with an accuracy of one part in a million. More recently, the interferometer has served as a link connecting the scales of γ-ray wavelengths with visible reference standards.

not need if we had more knowledge of the basic disease processes it seeks to correct. We would then either be able to prevent or treat cancer as we now prevent infectious disease with a vaccine or treat it with an antibiotic."

With examples like this, the question is, why *don't* we allocate vastly more resources to basic research?

For one thing, basic research is not commonly regarded as providing quick solutions to problems. It is usually thought of as a long-term investment which may not pay off for years or even decades. But we know that in the stepped-up tempo of modern life, the future gets here faster. New knowledge is put to work faster. If we fail to support science in its effort to re-supply the well of new knowledge at an ever accelerating rate, our doctors and engineers will go to that well someday and find it dry.

"Pay-off" of Basic Research

Since basic research is essentially an adventure into the unknown, there can be no guarantee of its practical application, now or anytime in the foreseeable future. We only know that there is a corollary between new knowledge and progress. Nothing could be more elementary, but we should remember that everything we know was once unknown. Many of the most commonplace objects of modern civilization were totally unknown only a few decades ago, and the time span between such objects being unknown and in common usage has shrunk with a rapidity that has made change the most dominant characteristic of modern life. Advanced technology flows from the new knowledge produced by basic research. This technology can then feed back as sophisticated laboratory equipment to enable basic research to probe further the secrets of nature.

But it takes patience. Each new discovery may at first appear to be an isolated fact, unrelated to anything much and certainly unimportant in our limited perspective. In time it may prove to be part of a jigsaw puzzle that reveals a new and hitherto undreamed of picture of some field of learning. That revelation can lead to technological achievements which the original researcher had neither sought nor even imagined.

Certainly Roentgen was not seeking a therapeutic and diagnostic weapon in the fight against cancer when he discovered X rays in 1895. Researchers in the fields of solid-state physics and electro-chemistry certainly had no idea their discoveries would someday be the foundation for xerography. Nor did those working on magnetic theory and frequency modulation realize their work would be essential to the development of the video-tape recorder.

turn page

Two teams of NBS scientists used photochemistry to increase the concentrations of specific isotopes of chlorine and boron in samples of the two gases. The technique, in which molecules containing the desired isotope are selectivity excited with light from a laser to increase their reactivity, may have application in medical research, where such isotopes are used. Here, Dr. Richard Keller inspects the setup used to excite molecules containing isotopes of chlorine.

One of the most exhaustive studies of the value of basic research has been carried out by Dr. Julius H. Comroe Jr., professor of physiology and director of the Cardiovascular Research Institute at the University of California, and the late Dr. Robert D. Dripps, professor of anesthesia and vice president for health affairs at the University of Pennsylvania.

The study centered on cardiovascular and pulmonary diseases and traced the many hundreds of key discoveries made over the years and even centuries that were required for recent advances in the two fields. One of their principal conclusions, following several years of study, was that basic research, as they saw it, paid off in terms of key discoveries almost twice as handsomely as other types of research and development combined. Such studies as this raise serious questions about the present level of expenditures for basic research to meet the needs of our increasingly complex and science-based society.

Funding

The National Science Board has recently issued a survey of research and development expenditures through 1974, the latest year for which figures are available. It shows that of the total national R&D expenditures of $32 billion in 1974, only $4 billion, or 12.5 percent, went for basic research. If we eliminate inflation, the Nation's total funds for basic research in constant 1967 dollars had decreased so that in 1974 they were equal only to the 1965 level. Federal support for basic research has declined about 23 percent in terms of constant dollars since 1968.

But it is good to know that under President Ford's leadership, Federal expenditures for this vital activity would begin to increase again in Fiscal 1977. In late March, in a special message to Congress, the President urged enactment of his '77 Budget requests for science and technology that included $2.6 billion for basic research, an increase of 11 percent over FY 1976.

"Through basic research," he declared, "new knowledge is achieved that underlies all future progress in science and technology." Pointing out that since much of the Nation's basic research is carried out at colleges and universities, the President said, "I have given special emphasis to the budget request for the National Science Foundation and other agencies that support research in these institutions. I have requested an increase of 20 percent in NSF's funding for basic research in order to underscore my strong support for such research, particularly in colleges and universities."

The President's total requests for all research and development activities of Federal agencies were $24.7 billion. This represents an increase of 11 percent, the same percentage increase for basic research.

Advice to President

Another major step the President has taken in the research area is his proposal for establishment of the Office of Science and Technology Policy in the White House. In his message to Congress, he pointed out that "This will permit us to have closer at hand advice on the scientific, engineering, and technical aspects of issues and problems that require attention at the highest levels of Government." I am confident that basic research will be one of this new Office's major concerns.

A third important consideration by

the President is the need for Federal policies that stimulate private investment in science and technology. He emphasized in his message that this objective is pursued through our tax laws, cooperative R&D projects involving industry and government, and other incentives.

This is an area of particular concern to me as Secretary of Commerce. Basic research is critical to industry's ability to create the new products and processes that add to our standard of living, increase productivity, maintain our technological leadership, and sharpen our competitive position in the world market.

But for industry, the problem of the unpredictability of basic research is particularly acute. To justify investment of any kind, industry needs assurances that it has a good chance of paying off within a reasonable time. Basic research obviously cannot meet this criterion, especially for smaller firms. As a result, industry places its heaviest bets on applied research and development, whose specific goal is commercially viable products and processes.

Industry Investment

This means that the Federal Government, in its corporate role concerned with progress of the whole Nation, must—and does—provide the lion's share of funds for basic research. Private industry provided only 16 percent of the total national expenditures for basic research in 1974. Taking into account the effect of inflation, those expenditures were at approximately the same level as 1961.

Of the total R&D expenditures in industry, basic research received only 3 percent. This, despite evidence that recent technological advances may depend increasingly on new scientific discoveries. Studies also show that the time between research and its utilization in technology is rapidly decreasing. One survey of the period 1970–73 shows an average time interval of only 3 years for this process to take place; in the 1960's, 6 or 7 years were required.

If basic research is so important to industrial progress, can some way be found to make it a more attractive investment to companies? Would it be possible for firms in an industry to join together, possibly through their industry association, to finance basic research on a cooperative basis, with the findings available to all?

Dr. Carlyle G. Caldwell, president of the National Starch and Chemical Corporation, recently cited such a cooperative undertaking by members of the Corn Refiners' Association, who supported basic research in the field of carbohydrate chemistry back in the 1940's. Although the program had no commercial goals, the fundamental knowledge it generated became the basis of numerous specialty starches and sugars. Without such research, it is estimated that many of these products would have been delayed some 15 years.

One of the leading advocates of basic research in industry is Dr. J. E. Goldman, group vice president for Research and Development and chief scientist of Xerox Corporation. He declared recently that "the industry that hopes to stay in business and keep relevant technologies up to date has the ultimate responsibility to do basic research." He also alluded to the intensification of research activity abroad, and the need for American industry to remain competitive.

Competing in World Market

The link between basic research and our competitive position in the world market may be reflected in at least two critical measurements. One is in productivity growth, which depends increasingly on modern technology. In recent years, U.S. gains in productivity have been among the lowest of all the industrialized nations. Studies also show that the percentage of U.S. basic research to total research and development has been only about two-thirds that of West Germany, Japan, and Canada.

Many other factors besides basic research can influence productivity, including the ratio of capital investment to total output, the quality of labor and managerial skills, and education. But the parallel in the declines in U.S. basic research and productivity growth cannot be dismissed. And productivity is a foundation stone for a rising standard of living.

A second relationship between basic research and our competitive ability in the international economy involves export of products with a high content of research and development. Our balance of trade depends increasingly on a continuous infusion of new and innovative products for export, as other countries acquire the ability to manufacture older products. This clearly indicates that basic research, as the well spring of such new products, should have steadily increasing support from all sectors—industry, government, and universities and other nonprofit institutions.

But the new knowledge that goes into such innovative products has a much more important role to play than a narrowly nationalistic one involving trade balances.

continued on page 21

HIGHLIGHTS

MIUS Program

The first community-wide demonstration project to compare the economy, reliability, and efficiency of a Modular Integrated Utility System (MIUS) with a conventional utility system is now underway at St. Charles, Md. The Department of Housing and Urban Development is sponsoring the MIUS which will provide the community's electric power, heating and cooling, domestic hot water, liquid waste and solid waste processing and potable water. NBS, one of several Federal agencies cooperating in the program, will evaluate the plant design and measure and evaluate plant performance with an instrumentation system designed by the Bureau.

Wind Tests on Mobile Home

NBS is currently conducting a field experiment in the measurement of wind effects on a mobile home. A typical 18.29 m × 3.66 m mobile home has been mounted on a turntable to allow the effects of several controlled angles of wind attack to be studied. Measurements are being made of the wind environment, pressures on the skin of the mobile home, total forces on the entire structure, and structural response. The project is sponsored by the Department of Housing and Urban Development, with the aim of developing wind load design criteria for mobile homes.

Computer "Benchmark" Guidelines

NBS has issued guidelines to help computer users develop and conduct benchmark mix demonstrations in the evaluation of computer systems for competitive procurement. "Guidelines for Benchmarking the ADP Systems in Competitive Procurement Environment" (FIPS PUB 42) will help Federal agencies plan and conduct benchmark mix demonstrations to validate hardware and software performance. They emphasize selection of samples of standard programs that are representative of the user's predicted actual workload at a minimum cost to both the computer user and the computer vendor. Order the publication from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. Use SD Catalog No. C13.52:42. Price 45 cents.

New Lead SRM

A new Standard Reference Material for chemical assay and isotopic composition of lead-206 has been issued by the Office of Standard Reference Materials as SRM 991. This SRM is intended for use by mass spectrometrists interested in making lead measurements by isotope dilution mass spectrometry techniques and also for geochronologists interested in making lead dating measurements. SRM 991 is supplied as a 15 gram solution in a quartz break-seal ampoule. It is available for $120.00 through the NBS Office of Standard Reference Materials, B311 Chemistry Building, Washington, D.C. 20234.

Test Method for Pressure Transducers

A recently developed test method for determining the effects of thermal transients on the performance of pressure transducers is explained in NBS Technical Note 905. The new NBS method is simpler, more reliable, and less expensive than other techniques. Tests of 25 commercial transducers, using the new method, showed zero drifts ranging from 0.4 percent to about 400 percent. Experimental investigation of ways to mitigate these effects is planned.

NBS Technical Note 905 may be ordered from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Use SD Catalog No. C13.46:905. Price $1.10.

Power-Saving Cathode Design

At least a 10 percent improvement in efficiency can be expected from a new cathode design for electric-discharge visible-wavelength lasers. Researchers from NBS and Colorado State University, using the new slotted cathode design, observed 18 new cw laser transitions in a silver-neon discharge mixture spanning the wavelength region 408 to 585 nm. They obtained 5 mW of cw output power from a copper-neon discharge and 250 mW with quasi-cw operation in the ultraviolet at 250 nm—the highest uv laser output reported to date.

Fire Deaths at Home

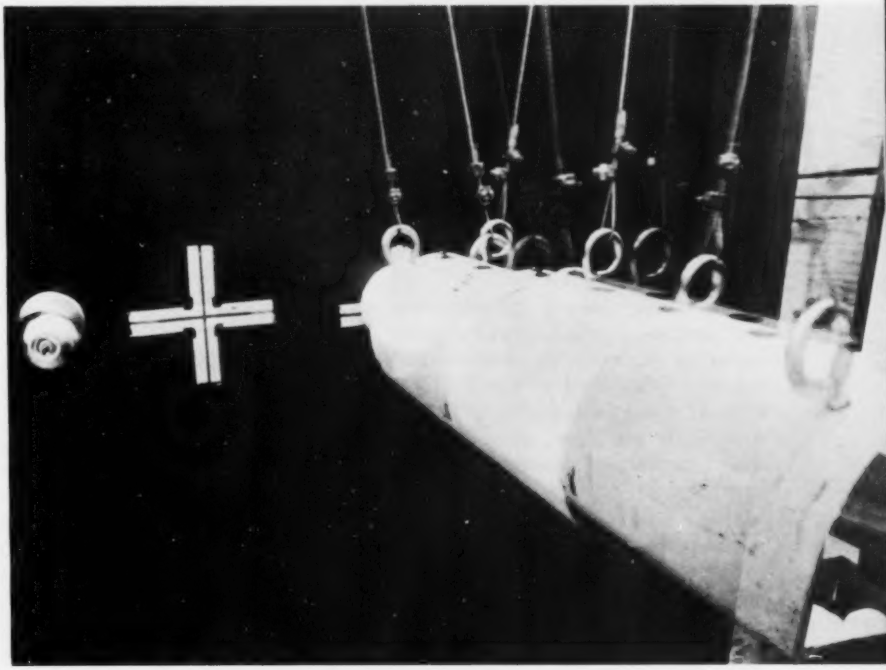
Most fire deaths in the United States occur in the home, according to research carried out jointly by NBS and the National Fire Protection Association. Twenty-seven percent of all U.S. fire deaths are caused by the careless smoker whose cigarette, pipe, or cigar ignites home furnishings such as mattresses, bedclothes, or upholstered furniture. The next most typical fire death also occurs at home and involves furnishings which are ignited by an open flame. □

NBS Develops Door Security Standard

WITH residential burglary losses exceeding $750 million a year, a new voluntary door security standard has been developed to help thwart "crimes of opportunity" against homes and small businesses.

The standard, providing performance requirements for door assemblies which will resist break-ins, was developed by the Law Enforcement Standards Laboratory (LESL) of the National Bureau of Standards.

Titled, "Physical Security of Door Assemblies and Components," the standard was prepared for the Justice Department's Law Enforcement Assistance Administration through its National Institute of Law Enforcement and Criminal Justice. Homeowners, tenants, architects, government agencies, homebuilders, and materials and hardware manufacturers are expected to find ready application for the standard in the nationwide effort to strengthen the community's defenses against burglary and violent crime.



Typical forces applied by criminals breaking into houses, apartments, and business premises are simulated in NBS performance tests using a pendulum to apply graduated levels of impact against a test door assembly.

Addressed to the prevention of "opportunity" crimes committed by unskilled and semi-skilled burglars, the standard is concerned with typical entry doorways in residences and small businesses. Requirements are detailed for both the total door assembly and individual components such as hinges, lock, door, jamb/strike, and jamb/wall.

For purposes of the standard, door assemblies and components are classified by their relative resistance to forced entry. Four classes of door assemblies are established, ranking from the least to the most break-in resistant.

Designated as NILECJ–STD–0306.00, the standard, after describing general requirements, sets forth test methods starting with sampling, equipment, test fixtures, sample preparation, and test sequence. Tests are outlined for: bolt projection and strike hole, bolt pressure, jamb/wall stiffness, knob impact, cylinder core tension, cylinder body tension, knob torque, cylinder torque, cylinder impact, hinge pin removal, door impact, hinge impact, and bolt impact.

The test methods described in the standard can be specified by purchasing agents to insure that a particular equipment item meets the standard's requirements, and the tests may be conducted by a qualified testing laboratory.

Established by an interagency agreement between the National Bureau of Standards and the Law Enforcement Assistance Administration in 1971, LESL is supplying the law enforcement community and the general public with a variety of reports and user guidelines to aid in crime control.

Copies of NILECJ–STD–0306.00 may be obtained without charge from: the National Criminal Justice Reference Service, U.S. Department of Justice, Washington, D.C. 20531.

turn page

Symposium on Chemical Thermodynamics Planned

NBS *continued*

The Law Enforcement Standards Laboratory, at the request of the Law Enforcement Assistance Administration, is seeking source and product information concerning door assemblies and components which are resistant to forcible entry and are designed for use in residential and small business entrances.

Firms manufacturing door assemblies and components including doors, locks, hinges, jamb/strikes, and jamb/walls which meet the performance requirements of Voluntary National Standard NILECJ–STD–0306.00, "Physical Security of Door Assemblies and Components," have the opportunity of providing a list of such products for a limited time.

Those firms wishing to have their products included in the LESL report to LEAA should submit a list of specific products identified by catalog number and security level classification, together with supporting laboratory test data or independent testing laboratory certification, if available.

This is not a request for proposal nor does the Government intend to pay for the information solicited.

Product information should be directed to the Law Enforcement Standards Laboratory, National Bureau of Standards, Building 221, Room B150, Washington, D.C. 20234. □

THE National Bureau of Standards will hold a special one-day symposium on "Vistas in Chemical Thermodynamics" on July 23 at its facilities in Gaithersburg, Md.

At the symposium, several invited speakers will discuss problems and anticipated new developments in chemical thermodynamics in the light of recent accomplishments. Subjects to be discussed include the role of thermodynamics in national energy problems, industrial problems and chemical thermodynamics, extension of thermodynamic investigations into the high temperature region, irreversible processes, selected topics in molecular interactions, and thermodynamics in the critical region.

The symposuim is being held to recognize the contributions of research scientist Dr. Charles W. Beckett to the science of thermodynamics on the occasion of his retirement from NBS. Beckett has carried out numerous research programs involving the chemical thermodynamic properties of a wide variety of materials and using a variety of experimental and theoretical procedures. His work has focused on the measurement standards programs of NBS and on related research and development on heat, power, propulsion, and high temperature materials of interest to the Energy Research and Development Administration (formerly the Atomic Energy Commission), the Department of Defense, the National Aeronautics and Space Administration, and other Federal agencies. Prior to his coming to NBS in 1950, Beckett had worked at the University of California and at the Ohio State University.

The symposium is free and open to the public. Additional information may be obtained from Dr. George T. Armstrong, Chief, Thermochemical Measurements and Standards Section, National Bureau of Standards, Washington, D.C. 20234. □

NBS Begins New Program to Check Laser Measurement Procedures

This scanning device, using a 1 mW laser, reads codes on grocery items and transmits an electrical impulse to a computer which looks up the price of the item, updates the store's inventory, and transmits information to the checkers' terminal. The "star" in the rectangular slot is the light from the laser.

THE Boulder laboratories of the National Bureau of Standards will offer a new measurement assurance program (MAP) for the power and energy measurement of nominally 1 milliwatt (mW) helium-neon lasers. Beginning in July, the service will assist manufacturers and users of lasers and optical power meters in making more accurate and reliable laser power measurements.

The NBS program has been established in response to laser industry concern over the narrowing tolerances customers are requiring on power and energy ratings. Particular interest is expected from firms furnishing lasers for the new supermarket check-out systems which read product identification and price from the bar codes now on most market items.

NBS is aiming its first laser MAP at lower-power helium-neon lasers operating at a wavelength of 0.6328 micrometers because these devices make up well over half of all laser sales. The Bureau of Radiological Health (BRH) provided further motivation for improved measurement capability by issuing performance standards that will become effective in the summer of 1976.

BRH has classified lasers according to power and requires that every laser not designated as Class I bear a label corresponding to its class. For example, a Class II laser must bear a label warning against looking into the beam. However, if this laser exceeds 1 mW it could become Class III a (1 mW to 5 mW) or even Class III b (5 mW to 500 mW). The Class III a label not only warns against looking into the beam but also against viewing the beam with optical instruments, while the Class III b label warns against direct exposure to the beam. Thus a manufacturer is accountable to BRH for improper labeling if his laser, designated Class II, is really putting out power in excess of 1 mW, regardless of whether the discrepancy is due to an erroneous measurement, a power drift, or both.

"When a manufacturer comes to us he will find that the MAP involves much more than just our calibrating his power meter," says Aaron Sanders, manager of the NBS measurement assurance program for laser power and energy. "We allow him to evaluate his entire measurement process relative to ours because it is that total process, rather then the calibration of a specific instrument, which determines the quality of the manufacturer's measurements." Sanders adds, "What we're really trying to do is help him establish a quality control procedure for his laser power and energy measurements. In other words, NBS is offering a calibration service for measurement processes."

A participant in this measurement assurance program receives from NBS a transfer standard in the form of a power meter which has been critically evaluated and documented against the national standard at Boulder. However, he is not given the calibration constant for the meter. Instead he must calibrate it using his own reference standards and methods for laser power measurements. If he obtains a meter constant which is consistent with the Bureau value, NBS will furnish him with a calibration constant and uncertainty estimates for his own system. The manufacturer can then evaluate his production system against his reference standard whose calibration in turn is derived from the national standard. Should he deem his evaluation of the transfer standard to be unsatisfactory, NBS will help him locate and compensate for systematic errors and reduce imprecision in his instruments and procedures.

"We are working on another MAP," says Sanders, "which will cover laser power measurements below 0.39 microwatts, the Class I range. Lasers in this class don't require a warning label, but in Class II they do. This MAP, too, will not only promote more accurate power measurements but will aid manufacturers in avoiding labeling violations." Sanders expects the MAP for Class I power levels to be initiated by mid to late 1976.

The yearly cost to a participant in a laser MAP will be about $1,500. Firms interested in these new NBS services can contact Aaron Sanders, Electromagnetics Division, National Bureau of Standards, Boulder, Colo. 80302, (303) 499-1000, ext. 4341. □

GARMENT *continued*

cording to the area of the body covered and the looseness or tightness of the fit. Winger credits John F. Krasny and his staff with developing the classification concept.

"The concept of classification is based on accident data which show that loose fitting, flowing garments are most often involved in fire accidents. The chances of an accident decrease with the tightness of the garment," Winger notes. "Therefore, long, loose fitting garments would require the safest fabric," he adds.

Also, under the draft standard, a fabric would fall into one four classes, according to flammability. Class-one fabrics would be the safest; class-four fabrics would be banned from use. Garments would fall into one of three categories, with "one" being the loosest—and most hazardous—and "three" being the safest and tightest-fitting.

The draft standard would require the fabric manufacturer to test all of his material to identify its flammability class. The garment manufacturer would be required to classify his designs according to the type of fit as determined by length and width measurements. He would then compare his classification with a tabulated chart that tells him which class of fabric he is allowed to use.

The staff of the Consumer Product Safety Commission is reviewing the draft standard with respect to compliance testing, economic impact, and technical feasibility. The Commissioners will decide how to proceed. It may be 3 years or more before a final standard is effective in view of the need for providing an opportunity for industry to comment and then to prepare to meet the standard when it becomes effective. □

FANS *continued*

window shading, weatherstripping, and caulking. Other measures include insulation in uninsulated exterior walls, storm windows, storm doors, and insulation around ducts and under floors over unheated areas.

To Ventilate or Not to Ventilate

Siu stresses that the general conclusions stated above may only apply to buildings similar in design to the building tested and should only be considered as applicable to simultaneous operation of an air conditioner and an attic ventilation fan.

Many families use attic fans to provide natural cooling at night or during the day by drawing cooler, outdoor air through the living space in lieu of air conditioning. Indeed, it is not only possible, but practical and often economic, to maintain a comfortable home in summer in many parts of the United States without relying on central air conditioning.

But if you do have central air conditioning and are looking for ways to reduce energy use and cut fuel bills, the NBS engineers advise considering other energy conservation measures first—such as attic insulation, storm windows, and caulking.

These measures, when properly installed, are valuable all year round and will lead to permanent energy reductions. Often they will have short payback periods, depending on the climate and the price of energy used to heat and cool the house. After making these improvements, you might still want to consider installing an attic fan, but it should be regarded as an alternative to air conditioning for intermittent use when outdoor temperatures are suitably low, rather than a device to be used simultaneously with an air conditioner. □

Attic Fan Mode	Daily Energy Consumption (kw-hr) Air Conditioner	Attic Fan	Total Energy	Percent •Difference
1. Fan off	141.7	0	141.7	0
2. Cyclic 4 hr. on/off cycle; on @ 8 a.m.	139.3	8.4	147.7	+ 4.2%
3. Fan on when attic temp. exceeded outdoor temp. by 8 °C	146.3	3.7	150.0	+ 5.8%
4. Fan off 8 a.m.-8 p.m. Fan on 8 p.m.-8 a.m.	151.4	8.5	159.9	+12.8%
5. Fan on	150.4	16.7	167.1	+17.9%

In this connection, I would point out that we hear much about America's responsibility as a world power to help keep the peace. As a former Secretary of Defense, as a veteran of the D–Day landing at Normandy beach, and as a citizen, I fully subscribe to that need.

National Goals

But in this Bicentennial year, as we seek to identify the goals of the Republic into its third century, I would suggest another consideration among our responsibilities. It is my conviction that today, and increasingly in the future, America's responsibilities in the world must be defined primarily in terms other than military. I believe we must especially place greater emphasis on our humanitarian goals. Just as the Declaration of Independence lit the torch of freedom for men everywhere 200 years ago, so might a new American commitment to humanitarianism help rekindle the hopes of today's world.

One way to state the commitment—and to fulfill it—is through new knowledge. Nothing else offers as much hope for progress against the ancient enemies of mankind—ignorance, poverty, disease, hunger, and despair.

No nation is better equipped than the United States to carry out the scientific research that produces new knowledge and understanding. We have the trained scientists, the educational institutions, and the laboratories required for the job. We have the industries that can take new knowledge and rapidly turn it into useful technology. We have the national wealth required for the investment.

Let us make the commitment to produce new knowledge to the fullest extent of our capabilities. Dr. Vannevar Bush called science "the endless frontier." It may also be the gateway to a new era of hope for all the world's peoples. I believe America could have no higher goal than to help open this gate during its third century. □

In the late 1940's, the work of Dr. William Meggers of the Atomic and Radiation Physics Division led to the development of the NBS-Meggers Mercury 198 lamp. Proposed by NBS as the first atomic basis for a standard of length, it could be calibrated with an accuracy of 1 part in 100 million.

might be expected to pursue specialities as a life's work. The same will apply to faculty members. But there must be an overall concept that all of these specialities are somehow part of an integrated whole. This certainly requires that in the university part of the creation of the new profession there be a strong contribution from individuals whose zeal and capability are the generalization of the whole and the integration of all the parts.

School of Hard Knocks

Certainly for the profession itself, if it is to develop as quickly as possible, we shall have to create mergers from various professions. There are now people in business, government, law, medicine, sociology, (and even engineering) who agree on the points being expressed here and who, in making their individual contributions, could properly be labeled "school of hard knocks" polylogists.

When an engineer becomes a businessman or even conceivably a senator, or a physician becomes a university president, this does not necessarily mean he has become a polylogist, a member of the new profession we have been describing. He may have simply changed from one specialized, existing profession to another, neither of which is the new and presently missing profession.

In mentioning existing polylogists, I refer rather to individuals whose interests and contributions are in the broadest sense actually in the application of science and technology to the meeting of society's needs. The individuals who are in such situations today are engaged in their interactive, interdisciplinary activities more or less fortuitously. They have not been deliberately trying to create a pattern for a new profession.

If we want to do precisely that, the professional societies could be helpful. Leaders in engineering should be interested in broadening engineering to meet a social need. Those concerned, even though they are not engineers, with the operation of major science and technology centers also should be interested. So should leaders of the academies and the major philosophical societies, as should university presidents, and heads of technological corporations and of those large government organizations that have a heavy dependence on science and technology.

A Fraternity

All engineers might encourage the bringing of people into our fraternity who are not normally thought of as engineers, this if they are engaged in a distinguished way in contributing to the fullest use of science and technology for the benefit of the world. Many consulting engineers come closer in certain respects to having a beginning foundation for "greater engineering" than do, say, computer engineers or aerodynamists. However, in general, all engineers tend to have been organized and categorized by technical specialities rather than through the route of interdisciplinary activities and seldom through the merging and matching of nontechnological with technological aspects.

Perhaps it is inevitable that the new profession will arrive only when it is ready to arrive as a result of eventual supply-demand pressures of the real world. More and more it will become apparent to thinking people that we are inadequately using, or in many instances actually misusing, these remarkable tools of man—science and technology. It will be seen we are missing too much.

Meanwhile, a steady flow of evidence will show what we might gain in rewards by improved vision and performance. The surfacing of the potential will attract outstanding intellects. Organizational patterns will begin to improve and intellectual disciplines will be developed. The new profession will evolve. I suspect it may still be called "engineering." Whatever it is called, it will be different, challenging, creative, and beneficial to the world, well beyond today's engineering. □

The Distinguished Lecture Series will be published later this year as a special proceedings, *Science and Technology in America: An Assessment*. To obtain copies, write to Dr. Robb Thomson, Assistant for Scientific Affairs, Room A402, Administration Building, National Bureau of Standards, Washington, D.C. 20234.

PUBLICATIONS

of the National Bureau of Standards

Acoustics and Sound

Quindry, T. L., Ed., *Standards on Noise Measurements, Rating Schemes, and Definitions: A Compilation*, Nat. Bur. Stand. (U.S.), Spec. Publ. 386, 1976 Edition, 84 pages (Apr. 1976) SD Catalog No. C13.10:386, $1.90.

Atomic and Molecular Studies

Kieffer, L. K., *Bibliography of Low Energy Electron and Photon Cross Section Data (through December 1974)*, Nat. Bur. Stand. (U.S.), Spec. Publ. 426, 210 pages (Mar. 1976) SD Catalog No. C13.10:426, $3.30.

Building Technology

Clifton, J. R., Fearn, J. E., and Anderson, E. D., *Polymer Impregnated Hardened Cement Pastes and Mortars*, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 83, 21 pages (Apr. 1976) SD Catalog No. C13.29/2:83, 55 cents.

Lew, H. S., Ed., *Wind and Seismic Effects*, Nat. Bur. Stand. (U.S.), Spec. Publ. 444, 462 pages (Apr. 1976) SD Catalog No. C13.10: 444, $5.80.

Computer Science and Technology

Watkins, S. W., and Abrams, M. D. *Interpretation of Data in the Network Measurement System*, Nat. Bur. Stand. (U.S.), Tech. Note 897, 46 pages (Mar. 1976) SD Catalog No. C13.46:897, $1.15.

Electromagnetic Metrology

Sawyer, D. E., and Berning, D. W. *Semiconductor Measurement Technology: Laser Scanning of Active Semiconductor Devices —Videotape Script*, Nat. Bur. Stand. (U.S.), Spec. Publ. 400-27, 26 pages (Feb. 1976) SD Catalog No. C13.10:400-27, $1.20.

Electronic Technology

Bullis, W. M., Ed., *Semiconductor Measurement Technology. Progress Report, January 1 to June 30, 1975*, Nat. Bur. Stand. (U.S.), Spec. Publ. 400-19, 95 pages (Apr. 1976) SD Catalog No. C13.10:400-19, $2.10.

Lieberman, A. G., *Semiconductor Measurement Technology: ARPA/NBS Workshop IV. Surface Analysis for Silicon Devices*, Nat. Bur. Stand. (U.S.), Spec. Publ. 400-23, 238 pages (Mar. 1976) SD Catalog No. C13.10:400-23, $3.70.

Energy Conservation and Production

Hunt, C. M., and Treado, S. J., *A Prototype Semi-Automated System for Measuring Air Infiltration in Buildings Using Sulfur Hexafluoride as a Tracer*, Nat. Bur. Stand. (U.S.), Tech. Note 898, 24 pages (Mar. 1976) SD Catalog No. C13.46:898, 55 cents.

Engineering, Product and Information Standards

Branstad, D., and Krell, R., *Glossary for Computer Systems Security*, Nat. Bur. Stand. (U.S.), Fed. Info. Process, Stand. Publ. (FIPS PUB) 39, 19 pages (1976) SD Catalog No. C13.52:39, 60 cents.

Chaconas, G. S., *Paints and Inks for Art Education in Schools (ANS 2297.1-1975)*, Nat. Bur. Stand. (U.S.), Prod. Stand. 65-75, 7 pages (Mar. 1976) SD Catalog No. C13.20/ 2:65.75, 35 cents.

Lasers and Their Applications

Danielson, B. L., and Beers, Y., *Laser Attenuators for the Production of Low Power Beams in the Visible and 1.06 μm Regions*, Nat. Bur. Stand. (U.S.), Tech Note 677, 25 pages (Jan. 1976) SD Catalog No. C13.46: 677, $1.20.

Metrology: Physical Measurements

Nicodemus, F. E., Ed., *Self-Study Manual on Optical Radiation Measurements: Part I —Concepts, Chapters 1 to 3*, Nat. Bur. Stand. (U.S.), Tech. Note 910-1, 93 pages (Mar. 1976) SD Catalog No. C13.46:910-1, $2.10.

Teague, E. C., *Evaluation, Revision and Application of the NBS Stylus/Computer System for the Measurement of Surface Roughness*, Nat. Bur. Stand. (U.S.), Tech. Note 902, 151 pages (Apr. 1976) SD Catalog No. C13.46:902, $2.70.

Wise, J. A., *Liquid-in-Glass Thermometry*, Nat. Bur. Stand. (U.S.), Monogr. 150, 30 pages (Jan. 1976) SD Catalog No. C13.44: 150, 85 cents.

Hubbell, J. H., and Veigele, W. J., *Comparison of Theoretical and Experimental Photoeffect Data 0.1 keV to 1.5 MeV*, Nat. Bur. Stand. (U.S.), Tech Note 901, 43 pages (Apr. 1976) SD Catalog No. C13.46:901, $1.15.

Publications listed here may be purchased at the listed price from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (foreign: add 25%). Microfiche copies are available from the National Technical Information Service, Springfield, Va. 22151. For more complete periodic listings of all scientific papers and articles produced by NBS staff, write: Editor, Publications Newsletter, Administraion Building, National Bureau of Standards, Washington, D.C. 20234.

AN EQUAL OPPORTUNITY EMPLOYER

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington D.C. 20234

OFFICIAL BUSINESS
Penalty for Private Use, $300
RETURN POSTAGE GUARANTEED

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF COMMERCE
COM-215

U.S.MAIL

DNBS SERIA300SEISSDUE007R 1
SERIALS DEPARTMENT
XEROX UNIVERSITY MICROFILMS
300 N ZEEB RD
ANN ARBOR MI 48106